IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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| APPLICANTS: | Wolfgang Clemens et al. |
| SERIAL NO: | 10/517,750 |
| FILED: | June 10, 2005 |
| EXAMINER: | Hoang Quan Tran Ho GROUP ART UNIT: 2818 |
| FOR: | Substrate for an Organic Field Effect Transistor, use of said Substrate, Method of Increasing the Charge Carrier Mobility and Organic Field Effect Transistor (OFET) |
| ATTY DKT NO.: | 411000-122 CUSTOMER NO.: 27162 |

DECLARATION OF WALTER FIX UNDER 37 CFR 1.132

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, Walter Fix, being duly deposed, hereby state:

1. Attached hereto is a paper showing some of my publications and related efforts in the field of organic transistor design and development. I am currently employed as Head of Technology in this field by PolyIC GmbH & Co. KG located in Germany and was previously employed by Siemens Aktiengesellschaft located in Munich, Germany performing work in the same field of endeavor in developing polymer electronics. I have a Phd. from the University of Erlanger-Nuremberg and wrote my Phd. thesis on optical transistors based on gallium arsenide devices. I have been actively employed in this design and development work since about 2000. This work requires monitoring of published literature in this field and keeping abreast of current technology in this field and performing development efforts with respect to new and innovative structures relating to

organic electronic devices. I am now responsible for the process and printing development as well as device, chip and system design and for material tests and qualifications. As a result of this work, I am familiar with the prior art work of others and the state of the art in such organic devices.

2. I am familiar with and have studied the above-entitled application, its claims, and the Office Action dated August 6, 2008 in the above-entitled application including the amended claims in the above identified application as presented in the accompanying Supplementary Response under 37 CFR 1.116.

Claim 1 of the application identified above, as amended in the Supplementary Response, is as follows:

> In an electronic organic component, the combination comprising:
>
> a substrate of the electronic organic component; and
>
> an organic semiconductor functional layer coated on the substrate ;
> wherein said substrate comprises a biaxially stretched (well-ordered) plastic film such that the orderliness of the plastic film forms the applied functional layer into a well-ordered layer to thereby improve the electrical on/off properties of the component (underlining added)

In my opinion, the underlined portion is unobvious over and not anticipated by the cited references cited in the referenced Office Action for the following reasons:

3. The Action states:

Bao may not explicitly disclose the commonly used substrate . . . is a biaxially stretched, well ordered, plastic film. Carey teaches it is well known in the art to provide such polyester substrate as a biaxially stretched, well ordered, plastic film. . . It is proper to combine Bao and Carey because they both teach analogous art . . .Bao may not teach that the organic semiconductor is coated on the substrate. However, fig. 6 of Shi teaches

it is known in the art to provide: a substrate . . . and an organic semiconductor functional layer . . . coated on the substrate.

4. However, the Action ignores the Shi disclosure which discloses uniaxially and not biaxial stretching. The biaxially stretching of a substrate to improve the electrical properties of a component employing an organic semiconductor functional layer is not suggested by the cited references especially Shi which appears to me to teach away from amended claim 1 above with a different structure that does not suggest or give a hint as to providing improved electrical properties of the claimed component of amended claim 1.

5. The amended claim 1 device comprises a substrate and an organic semiconductor coated on the substrate wherein the substrate is biaxially stretched to improve the electrical properties of the component. This structure, the semiconductor coated on a biaxially stretched substrate, is missing in and, in my opinion, is not suggested by the cited references, taken singly or together, including Shi, which discloses uniaxially stretching. Shi does not recognize improved electrical properties of an electronic component using a biaxially stretched substrate in combination with the claimed semiconductor coated thereon. The amended claim 1 specifically states that the electrical on/off properties of the component are improved over a component.

6. Bao is cited for teaching the substrate is commonly used and is polyethylene. The Office Action admits that this reference does not disclose the substrate is biaxially

stretched as claimed. Also this reference does not disclose a semiconductor layer coated on the layer of the polyethylene.

7. Carey is cited for teaching that it is known to provide such a polyester substrate is biaxially stretched. However, this reference discloses an isolation layer next to the substrate, not a semiconductor layer coated thereon as claimed, and therefore is not relevant to what is claimed. There is no recognition in this reference that an electronic component with a biaxially stretched substrate and a semiconductor functional layer coated thereon will exhibit improved electrical properties. The Action combines Carey with Bao, but this combination is not suggested by these references, and assuming arguendo the combination is so suggested, still does not suggest what is claimed. To combine Bao with Carey merely suggests that the so called substrate of Bao as having a stretched substrate as suggested by Carey, will also have an isolation layer next to the stretched substrate as disclosed by Carey, not a semiconductor layer as claimed. See Carey Figs. 1 and 2 disclosing an insulating layer of $SiO^2$ layer 11, an inorganic material, not a semiconductor and plainly not an organic semiconductor as claimed. There is no recognition in Carey that the disclosed biaxially stretched substrate will provide an electronic component with improved on/off electrical properties other than the uniaxially stretched substrate as disclosed by Shi.

8. The Carey construction would rearrange Bao in a manner contradicting Bao. It seems to me that it is improper to combine references to suggest a reconstruction of the reference in a manner making the Bao reference unsatisfactory for its intended purpose.

This proposed modification of Bao would change its principal of operation. There is no suggestion in these references, in my opinion, to make such a substitution apart from the disclosure in the above identified instant application, and to modify the references in view of that disclosure appears not sustainable to me, especially in view of certain of the facts as described below in paragraphs 11-13.

9. Shi is cited as disclosing a semiconductor deposited on a substrate and is combined by the Action with Bao and Carey. In my opinion, Shi points away from the above recited amended claim 1 and does not suggest the combination as asserted in the Action. Even if the proposed modification were proper as asserted contrary to the disclosures of the cited references to Bao and Carey as discussed above, the Action states that Shi teaches it is known to provide an organic semiconductor functional layer (64) coated on the substrate referring to Fig. 6. This is not a sufficient statement regarding the disclosure of Shi.

10. The Action ignores the impact, on one of skill in this art such as my self, of Shi's disclosure of a uniaxally stretched orientation film 63, Fig. 6, and importantly, ignores that this uniaxially orientation film is provided to orient the organic semiconductor functional layer in a uniaxial direction, and not biaxially as claimed, which is an important difference as explained below. See Shi's abstract, and col. 4, lines 51-57, stating "the orientation film acts as a foundation or seed for the organic semiconductor layer to grow or deposit uniaxially. " This teaches me that uniaxially stretching of a substrate is the way to construct such a device to improve its electrical properties. But Shi is silent as to the effect of biaxially stretching the substrate. Shi does not suggest this to me.

See also col. 4, lines 58-67 stating:

> "if a film of an organic polymeric semiconductor material with a linear [meaning uniaxally] extended π-conjugated backbone is used in the transistor, the orientation direction of the orientation film [uniaxial] is preferentially controlled such that the film of organic polymeric semiconductor material grows or deposits on top of the orientation film with extended π-conjugated backbone aligned in the source to drain direction [a uniaxial direction]." (underlining added)

See also the continuation of Shi's discussion at col. 5, lines 1-5, further emphasizing Shi's desired alignment is in the uniaxial linear source-drain direction. Therefore, to me, if I were to biaxially stretch the Shi substrate film in view of Carey as suggested by the Action, this would counter Shi's desired uniaxial linear orientation in the source to drain direction. Shi suggests to me that I should not use such a biaxially stretched substrate with a semiconductor. Such biaxial directions appear to me, without more, to conflict with Shi's desire to improve the orientation of the semiconductor film in this direction and thus to me, substituting a biaxially stretched substrate for a uniaxially stretched substrate as suggested by the Action would not in my opinion enhance the action of the Shi disclosed device, but rather would diminish the effectiveness of the device of the Shi disclosure. Shi's disclosure thus conflicts with and is contrary to the above recited amended claim 1 and does not suggest this structure.

11. Imagine, if you will, that stretching the plastic substrate in one direction would create a plurality of parallel strings of the polymer substrate in that direction. This creates an orientation of those strings having a relatively higher order of orientation (as compared to the plastic material prior to stretching) in that one direction with the array of such strings.

12. Now, imagine if you will, the polymer plastic substrate is stretched biaxially as claimed in the above recited claim 1 or as disclosed by Carey. The so called strings will no longer have a higher order of orientation in a given direction, because the strings will be stretched in a direction normal to that prior higher order, displacing the prior stretched strings in this normal direction and thus diminishing the so called higher order. As a result, the so called strings will become more randomly oriented due to this stretching of the material in the two normal directions, i.e., they no longer will be oriented primarily parallel uniaxially.

13. I am aware of tests conducted by my employer, that have shown unexpected and surprising improved electrical properties in an electrical component, such as in a transistor, comparable to that claimed in amended claim 1 above. These results have shown to me that there are improved on/off properties in the electronic component employing the amended claim 1 structure, i.e., enhanced performance of the component regarding its ON/OFF ratio and thus an improved performance wherein the component is operative with a more desirable lower threshold voltage with the structure as claimed in the above amended claim 1. The improved on/off ratio is inherent in the component comprising the biaxially stretched substrate on which the organic semiconductor is coated. That is, the improved on/off ratio always occurs in such a component as compared to other components without a biaxially stretched substrate.

14. ON/OFF ratio refers to the difference in the current density in the device depending upon whether the component, a transistor, for example, is on voltage or off voltage, i.e., a

voltage is impressed across the device or not. This ON/OFF ratio is dependent upon the background current of the transistor. If this background current is very high, the component needs an increase in current to have a desirable ON/OFF ratio. That is, there must be a significant difference between the voltage on current and the voltage off current in the component to improve the operating characteristics of the component such as a transistor.

If the background current is high, the component needs more current to have a high ON/OFF ratio, which more current is undesirable. That is, when a voltage is applied across the semiconductor layer via the gate, drain-source electrodes of a transistor for example, a current channel is created within the semiconductor. When that voltage is removed, the current channel should dissipate. However, it has been observed that the current channel may remain, i.e., becomes residual, with prior art substrates. If so, this residual current channel creates a background current in the component even in the absence of an applied voltage. If this background current is almost as high as the current induced when the voltage is applied, this produces a low ON/OFF ratio, which is undesirable for such components.

As the ON/OFF ratio is increased for a given component structure which provides an improved electrical performance as in amended claim 1, the component such as a transistor exhibits a more desirable ON/OFF ratio condition. That is, the component may be turned on with a lower voltage than otherwise might be possible. A lower turn on voltage for the component is always more desirable. This desirable feature of a biaxially stretched substrate is not recognized by or suggested by the references cited of record.

15. This enhanced performance from a biaxially stretched substrate is not understood, is unexpected and is surprising to me. As stated in certain of the paragraphs above, the higher order created by the uniaxial stretching of Shi is no longer present and thus the uniaxial advantage of Shi's device appears to be no longer present. I believe the improved electrical on/off performance of a component constructed as in amended claim 1 may be attributed to interfacial effects introduced by the transverse and biaxially stretching action, which effects are not disclosed in the cited references of record. These interfacial effects may be created by the change in distance between the strings as a result of the biaxially stretching. To me, intuitively, the reduction of the higher order orientation of the plastic material by the biaxially stretching would otherwise seem to result in a reduced ON/OFF ratio, and thus not an improved electrical performance as claimed. This increase in the improvement of the electrical property thus results in an enhanced performance of the component incorporating the subject matter of the above recited amended claim 1. This enhanced performance was totally unexpected, especially in view of Shi, which does not teach such enhanced performance of a semiconductor coated on such a biaxially stretched polymer substrate. Thus, contrary to the Action, I would not be motivated by Shi to combine Shi with the Bao and Carey disclosures as suggested by the Action. That combination is suggested by the above-entitled application and not by these references.

16. No motivation is provided me to combine Shi with Bao and Carey as suggested by the Action to do what is claimed since, as per paragraph 12, the biaxially stretching appears at first instance to diminish, not enhance, the operation and electrical properties

of an electronic component with a semiconductor on a biaxially stretched polymer substrate. In my opinion, none of these cited references including Shi, which teaches a different uniaxial orientation, suggest to me that a biaxially stretched film substrate would be advantageous to enhance the electrical performance of an electronic component structure as in amended claim 1. For the above reasons, in my opinion, amended claim 1 is believed unobvious over the above cited references.

17. Method claim 5 and device claim 7 include subject matter similar to amended claim 1 and are believed allowable for similar reasons.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date 17. DEZ. 2008

Walter Fix

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Dr. Walter Fix
Head of Technology

ATTACHMENT TO DECLARATION OF WALTER FIX

**Speakers at Organic Electronics Conference and Exhibition 2006**

PolyIC, Dr Walter Fix, Head of Technology, 13 MHz RFID transponders based on polymers, two. printed systems, Awed Hitler.

**Dynamic and lifetime measurements of polymer OFETs and integrated .. . .**

Jürgen FICKER, Andreas ULLMANN, Walter FIX, Henning ROST, Wolfgang CLEMENS SPIE proceedings series, 95-102, SPIE. Organic Field-effect Transistors(OFETs)

**OEC-06 Programme Overview**

Dr Walter Fix, Head of Technology PolyiC. 11:30-12:00. Developments in printed RFID tags.
Klaus Dimmler, CEO & President, OrganicID. 12:00-12:30 . . .

**A Polymer Transistor Circuit Using PDHTT**

Jürgen Krumm, Elke Eckert, Wolfram H. Glauert, Member, IEEE, Andreas Ullmann, Walter Fix, and. Wolfgang Clemens, Abstract—A digital circuit using polymer

**PUBLISHED PAPERS**

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## PATENTS AND PATENT APPLICATIONS

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